INTERNATIONAL JOURNAL OF BEHAVIORAL DEVELOPMENT, 1995, *18* (2), 277–295

Using the HOME Inventory with Infants in Costa Rica

Betsy Lozoff

University of Michigan, Ann Arbor, Michigan, USA

Angela M. Park

Case Western Reserve University School of Medicine, Cleveland, Ohio, USA

Angela E. Radan

Hospital Nacional de Niños and University of Costa Rica, San Jose, Costa Rica

Abraham W. Wolf

Case Western Reserve University School of Medicine, Cleveland, Ohio, USA

This study determined the psychometric properties of the HOME (Home Observation for Measurement of the Environment) Inventory in a Latin American sample. HOME data for 183 healthy Costa Rican infants were compared to the original HOME standardisation sample from Little Rock. The Costa Rican total HOME average of 29.8 ± 6.7 was similar to the scores of families in Little Rock (mean = 31.2 ± 7.3). Measures or internal consistency and factor structure were similar in US and Costa Rican samples. In contrast to

Requests for reprints should be sent to Betsy Lozoff, Center for Human Growth and Development, University of Michigan, 300 North Ingalls, Ann Arbor, Michigan 48109-0406, USA.

The work was supported in part by a grant from the National Institutes of Health (HD14122). We gratefully acknowledge the Costa Rican families' commitment to continued participation in the project. We are indebted to Dina Krauskopf for help in training the home observers, to Norma Britto, Lili Fernandez, and Patricia Alvarado, who made the HOME observations along with one of the authors (AR), and to Maria Elena Chacon for performing the cognitive tests. We also appreciate the thoughtful comments and support of Robert Bradley and Edward C. Nelson and the editorial assistance of Stephen Malone. Preliminary results of this study were presented in a poster session at the International Conference on Infant Studies, Montreal, 1989.

these similarities, Costa Rican HOME scores showed no significant correlation with developmental test scores in infancy (Bayley MDI), and the correlation with Full Scale IQ (WPPSI) at five years was modest, albeit statistically significant ($r = 0.28, P < 0.05$). These relationships were similar to those of Mexican-American children in a recent collaborative study by Bradley et al., 1989 and not as strong as for US white and black populations. However, when the concept of outcome was broadened beyond IQ scores to include child health and development in general, the HOME seemed sensitive to important environmental differences in this Costa Rican group. Lower HOME scores related to a shorter duration of breastfeeding and differentiated children with iron deficiency anaemia in infancy, a condition associated with long-lasting developmental disadvantage. Thus, the HOME was helpful in identifying children at risk for delayed development in this Latin American sample.

Several decades of research have established that children's home environments exert important influences on their development. There has also been considerable interest in expanding research beyond indirect measures of the home environment, such as socioeconomic status, to help understand the nature of specific environmental mechanisms that influence early behaviour and cognitive development.

The Home Observation for Measurement of the Environment (HOME; Caldwell, Bradley, & Staff, 1984) was developed to pursue such interests. The HOME was designed to measure the quality of stimulation (cognitive, social, and emotional) in a child's early family environment. Versions of the HOME have been developed for children of differing ages. The Infant/Toddler version, which is the focus of this paper, has been studied most extensively. Subscales of this measure emphasise aspects of the home environment such as the parent's involvement with the child, the types of toys available to the child, and the types of punishment used.

Subsequent to its development, a number of studies have found the Infant/Toddler version of the HOME to be a valid and reliable instrument (Bradley & Caldwell, 1977; Caldwell et al., 1984; Hollenbeck, 1978; Mitchell & Gray, 1981). Other studies have documented the HOME's ability to predict later intellectual development (Bakeman & Brown, 1980; Barnard, Bee, & Hammond, 1984; Bee et al., 1982; Bradley, 1982; Bradley & Caldwell, 1976, 1980, 1984; Bradley, Caldwell, & Elardo, 1979; Elardo, Bradley, & Caldwell, 1975; Siegel, 1981; van Doorninck, Caldwell, Wright & Frankenburg, 1981). Correlations between HOME scores in infancy and later IQ typically range from $r = 0.30$ to $r = 0.59$. However, other approaches to assessing the HOME's validity, in addition to predicting IQ curves, are also important.

An additional concern is that almost all studies of the HOME's reliability and validity have been conducted with US samples. Nonetheless, the

HOME is being used in other countries. For example, it has been applied in studies of lead exposure in other industrialised societies (Cooney, McBride, Bell, & Carter, 1989; McMichael et al., 1988; Moore, Bushnell, & Goldberg, 1989) and of malnutrition in developing countries (Cravioto & DeLicardie, 1972; Grantham-McGregor, Powell, Stewart, & Schofield, 1982). Several questions thus arise: Does the HOME have similar psychometric properties when used with samples drawn from countries other than the United States? Is the HOME a valid instrument for these children, not simply in predicting later cognitive function but also in differentiating other important outcomes? Most important, is the HOME an appropriate measurement tool for non-US samples?

The study reported here assessed: (1) whether the psychometric properties of the HOME based on US samples parallel those found in the Latin American country of Costa Rica; and (2) whether the HOME discriminates between Costa Rican environments with different associations to child health and development. Our original expectation was that the psychometric properties of the HOME in Costa Rica would differ substantially from those in the United States, even though lower HOME scores would still identify children with poorer developmental outcome within this society.

SOURCES OF INFORMATION AND METHODS

Subjects

Costa Rica. The data for this study were collected during the course of a study on the effects of iron deficiency in infancy (Lozoff et al., 1987). The original study involved 191 healthy Costa Rican infants from the urban community of Hatillo, a socioeconomically and ethnically homogeneous community, inhabited by primarily lower-middle class residents. The sample was collected between 1983 and 1985 through door-to-door screening of the entire community. Infants included in the study were born at term of singleton uncomplicated births, free of any chronic or acute illnesses, and had normal physical examinations by an experienced paediatrician.

Complete HOME and Bayley data were available for 183 of the 191 infants. Infants in the final sample ranged in age from 12 to 23 months; mean age was 16.6 ± 3.2 months. Fifty-seven per cent of the sample was male. The mean birthweight was 3.4 ± 0.9 kg. Mothers averaged 25.4 ± 5.6 years of age at the time of the infant's birth. Maternal education averaged 9.5 ± 3.3 years; mean paternal education equalled 10.5 ± 3.4 years. Demographic data (Table 1) are presented in a format directly comparable to that published in the HOME manual (Caldwell et al., 1984, p. 15).

Eighty-five per cent of the children in the sample were re-tested when they were 5 years of age (Lozoff, Jimenez, & Wolf, 1991). This longitudinal

follow-up expands the study beyond development during infancy and permits the determination of the relationship between the early home environment and cognitive functioning at school entry.

Although the sample was recruited for a study of iron deficiency, it should be emphasised that these are "normal" children who had not been identified by their families or their health care providers as having problems of development or health. The sample is also similar in iron status to most infant populations in the world. Iron deficiency anaemia is the world's most common nutrient deficiency, affecting an estimated 25% of all infants (DeMaeyer & Adiels-Tegman, 1985; Florentino & Guirriec, 1984). The prevalence of iron deficiency anaemia among the Costa Rican infants, who were completely healthy in other respects, was 25%. The prevalence of iron deficiency anaemia in clinic populations in the United States was also approximately 25% at the time of data collection to develop the HOME (Lane & Johnson, 1980).

United States. The Costa Rican data were compared in detail to the sample in Little Rock, because extensive information was available for the latter sample. Some other samples, restricted to low birthweight infants of middle-class families, seemed less appropriate for comparison (Gottfried &

TABLE 1
Demographic Characteristics

	Sample	
	Little Rock (N = 174)	*Costa Rica* (N = 183)
Family data		
Parental education (years)		
Mother	12.2	9.5
Father	12.9	10.5
Father absence (%)	30	24
Unemployed (%)	34	12
Child data		
Sex (Female) (%)	50	43
Age group (%)		
4–12 months	39	
13–24 months	34	100
25–36 months	27	
Birth order (%)		
First-born	53	32
Second/Third	30	46
Fourth/Later	17	22

Gottfried, 1986). Although neither the Little Rock sample nor the Costa Rican sample are as narrowly circumscribed, they still cannot be considered representative samples. Neither used a sampling strategy to represent the entire country, with proportional sampling of different geographical regions, ethnic groups, social class, etc. Instead, both were geographically circumscribed samples, largely of lower- and lower-middle class families.

The Little Rock sample consisted of 174 infants from lower-middle class families, all from the community of Little Rock, Arkansas (Caldwell et al., 1984). Participants were recruited beginning in 1970, from data of well-baby clinics, hospital birth records, and personal contacts of Caldwell. Infants ranged in age from 4 to 36 months of age. Average paternal and maternal education equalled 12.9 years and 12.2 years, respectively (standard deviations not presented in the manual). Other demographic characteristics are shown in Table 1. Unemployment in the Little Rock sample was inferred from the percentage of families on welfare.

Procedures

Home Environment Assessment. In both samples, the family home environment was assessed by means of the Home Observation for Measurement of the Environment (HOME), using the Infant/Toddler version (birth to age 3 years) (Caldwell et al., 1984). The scoring of items entails direct observation and interviews with the participants in the child's home while the child is awake and with as little disruption as possible to the child's normal daily routine. HOME items, which are scored on a Yes/No basis, are grouped into six schedules: (1) Emotional and Verbal Responsivity of Parent; (2) Acceptance of Child's Behaviour; (3) Organisation of Physical and Temporal Environment; (4) Provision of Appropriate Play Materials; (5) Parent Involvement with Child; (6) Opportunities for Variety in Daily Stimulation. Scores on all items in a given subscale are totalled to give a subscale score. Subscale scores are then combined to yield a total score for the HOME measurement.

At the outset of the study in Costa Rica, the research team's psychologists were concerned that the HOME would not accurately portray the stimulation that Costa Rican children receive. The reasonableness of this concern led us to record and score HOME data in two ways: (1) exactly as specified in the manual for use with US samples: and (2) with an "experimental" notation that could be used for every item, in which the observer could mark environmental features that were in the spirit of a given HOME item but did not meet the standard criteria. For instance, this notation allowed team psychologists to indicate that a family had books but fewer than 10 were visible or that an older sister (but not the mother) read stories to the child. The intention was to record observations that might

otherwise be lost, an empirical exploration without fixed criteria. We arbitrarily decided at the outset that an "experimental" HOME score would be calculated by giving 0.5 points for each annotated item. The plan was to formalise the method if analyses at the conclusion of the study indicated that it was more helpful than the standard method of scoring in differentiating Costa Rican children with different outcomes.

One approach to validity measurement was to relate HOME scores to cognitive function, following the model of many US studies. To determine cognitive and intellectual functioning in infancy, the Bayley Scales of Infant Development (Bayley, 1969) were administered in both samples. The Wechsler Preschool and Primary Scale of Intelligence (WPPSI; Wechsler, 1967) was used to assess general cognitive functioning of the Costa Rican children at 5 years of age. In the Little Rock study, Caldwell and Bradley employed the Stanford-Binet Intelligence Test, which, like the WPPSI, is a widely used test of young children's intelligence.

Neither the Bayley nor the WPPSI has been standardised for Latin American cultures, and it is not the intention of this study to standardise them. However, the Bayley has been used in studies of iron deficiency in Guatemala (Lozoff, Brittenham, Viteri, Wolf, & Urrutia, 1982), Chile (Walter, de Andraca, Chadud, & Perales, 1989; Walter, Kovalskys, & Steckel, 1983), and Costa Rica (Lozoff et al., 1987) and has yielded mean values comparable to those obtained in US samples. In the present study the Bayley Mental Development Index or MDI of the Costa Rican children averaged 103.1 ± 15.3 (range 53–141). WPPSI scores were also similar to US norms, averaging 103.4 ± 12.0 (range 63–127) (Lozoff et al., 1991). Both tests were administered by experienced Costa Rican psychologists, unfamiliar with the child's background or HOME scores.

Pearson product-moment correlations were calculated to assess the relationships of HOME subscale scores, total scores, and factor loadings with Bayley MDI scores and WPPSI scores. These relationships provide evidence for one aspect of concurrent and predictive validity of the HOME in this Costa Rican sample. The degree of relationship was then compared to published data from the Little Rock sample (Bradley, Caldwell, Rock, & Harris, 1986), to summary data from a meta-analysis of five US studies (Gottfried, 1984), and to simple SES measures, such as parental education.

Another approach to assessing validity, possible only for the Costa Rican sample, was to relate HOME scores to other child health outcomes. Specifically, information on the duration of breastfeeding, iron status (haemoglobin, transferrin saturation, erythrocyte protoporphyrin, serum ferritin), and growth (weight, height, head circumference, left upper-arm circumference) was available to determine if the HOME related to aspects of child health and development other than IQ scores.

RESULTS

Psychometric Properties of the HOME Scale

To ascertain the usefulness of the HOME in Costa Rica, the Costa Rican data were compared with published psychometric data from US studies. Item scores, subscale scores, and total HOME scores were compared with corresponding means and standard deviations for the Infant/Toddler version published by Caldwell et al. (1984, p. 17). The means and standard deviations were surprisingly similar for the Little Rock and Costa Rican samples (Table 2). Subscale means for the Little Rock sample ranged between 2.78 and 8.48, with mean total HOME score equal to 31.2 ± 7.31. Costa Rican subscale means ranged from 2.50 to 8.54, with mean total score equal to 29.8 ± 6.72 (without any use of the experimental notation). Only on the third and fourth subscales (Organisation of Environment and Appropriate Play Materials) did the Costa Rican families perform significantly lower than the Little Rock families ($t = 2.18$, $P < 0.05$ for subscale 3; $t = 2.04$, $P < 0.05$ for subscale 4).

The internal consistency of the HOME subscales was estimated for the Costa Rican and Little Rock samples using the Kuder-Richardson 20

TABLE 2
Psychometric Properties

Subscale	*Sample*	
	Little Rock (N = 174)	*Costa Rica* (N = 183)
1. Emotional and verbal responsivity	8.48 ± 2.09	8.54 ± 2.05
	0.72	0.64
2. Acceptance of child's behaviour	5.57 ± 1.72	5.34 ± 1.66
	0.67	0.55
3. Organisation of environment	4.84 ± 1.13	4.59 ± 1.03*
	0.89	0.31
4. Appropriate play materials	5.98 ± 2.39	5.51 ± 2.04*
	0.77	0.65
5. Parental involvement	3.45 ± 1.62	3.27 ± 1.71
	0.69	0.66
6. Variety in daily stimulation	2.78 ± 1.25	2.50 ± 1.14
	0.44	0.42
Total HOME score	31.2 ± 7.31	29.8 ± 6.72
	0.89	0.84

Notes: Values are means ± SD. The Kuder-Richardson coefficient of internal consistency for each scale is given on the line below the means.

* $P < 0.05$.

formula. Internal consistency coefficients were comparable for both samples (Table 2). The internal consistency of the HOME scale in total was virtually equivalent, $r = 0.89$ for Little Rock and $r = 0.84$ for Costa Rica. Subscale 3, Organisation of the Environment, was the exception. The Kuder-Richardson coefficient was lower on this subscale for the Costa Rican sample than for the Little Rock sample ($r = 0.31$ vs. $r = 0.89$).

Experimental Notation. The Costa Rican psychologists made use of the experimental notation with approximately 80% of the children, involving an average of 1–2 items per child. However, three individual items were accounted for much of the notation. Item 23 (regular check-ups and preventing health care) was marked with the experimental notation in 90 children. In keeping with Costa Rican practice, many children had been vaccinated but did not have regular check-ups. Item 32 (toys for practising eye-hand co-ordination) was annotated in 57 cases, generally because the child practised such co-ordination with household items, such as kitchen pots, rather than with toys. Item 42 (mother reads to the child three or more times a week) was also noted quite often (52 children), usually because a sibling did the reading or there was a family custom of oral story-telling. The only other items that were annotated in more than 5% of the sample were items 18 (number of books in the house), 41 (paternal involvement), 43 (eating with parents daily), and 45 (child has three or more books), with partial meeting of the criteria for 11, 10, 13, and 23 children, respectively. HOME scores calculated with the experimental notation (arbitrarily giving 0.5 points for each annotated item) were highly correlated with the standard scores ($r = 0.995$ for total HOME score). Therefore, further data analysis used the standard scoring method.

Factor Analysis. To provide further information on the HOME in Latin America, a factor analysis was also conducted. To ascertain whether items clustered together in a similar fashion in US and Costa Rican samples, the factor analysis technique performed on the Costa Rican HOME data followed the procedures outlined by Stevens and Bakeman (1985) for a US sample. [Other studies also report factor analytic work with the HOME, but they do not offer as much detail about specific procedures and results (Bradley & Caldwell, 1984; Bradley, Mundifrom, Whiteside, Casey, & Barrett, 1994; Mitchell & Gray, 1981; Plomin, Loehlin, & DeFries, 1985).] Stevens and Bakeman (1985) factor analysed the 45 items of the HOME scale in a US sample using the principal components method and retained three factors for varimax rotation. An item was considered to load uniquely on one factor if its factor loading equalled or exceeded 0.40. The items of the Costa Rican HOME data were similarly analysed using a principal components method with three factors retained for varimax rotation.

Table 3 compares the results of the Costa Rican analysis to the published US data. A full comparison of the solutions for the two samples is not possible, however, because Stevens and Bakeman only report the loading for an item on its one unique factor.

The first two factors derived from the Costa Rican data corresponded

TABLE 3
Factor Analysis

	US Factor				*US Factor*		
HOME Item	1	2	3	*HOME Item*	1	2	3
Emotional and verbal responsivity of parent				*Provision of appropriate play materials*			
1. Spontaneous vocalisations to C		0.70/***0.67***		26. Muscle activity toys			
2. Responds to C's vocalisations		0.65/***0.54***		27. Push or pull toy			
3. Labels objects for C				28. Anything C can ride on			
4. Has distinct speech				29. Provides toys for C during interview			
5. Spontaneous comments to I		0.66/**0.31**		30. Mobile, table/chair playpen			
6. Conversational speech with I		0.66/**0.22**		31. Role-playing toy, cuddly toy	0.57/***0.41***		
7. Permits "messy" play				32. Toys: in and out, fit together	0.54/***0.51***		
8. Spontaneously praises C		0.59/**0.19**		33. Toys that permit combinations	0.59/***0.59***		
9. Positive feeling to C in voice			0.40/***0.60***	34. Toys for literature and music	0.56/***0.49***		
10. Caresses/kisses C							
11. Positive response to praise of C							
Acceptance of child's behaviour				*Parental involvement with child*			
12. Does not shout at C			0.69/***0.54***	35. Keeps C in visual range			
13. No hostility to C			0.68/***0.65***	36. "Talks" to C while working			
14. No slap or spank			0.62/**0.37**	37. Encourages development advance			
15. Used no physical punishment				38. Invests maturing toys with value	0.46/***0.76***		
16. No scolding or direct criticising			0.69/***0.56***	39. Structures C's play			
17. Does not restrict movements			0.67/***0.45***	40. Provides challenging toys	0.52/***0.71***		
18. 10 books visible	0.41/***0.46***						
19. Family has pet							
Organisation of physical & temporal environment				*Opportunities for variety in daily stimulation*			
20. No more than 1–3 caretakers				41. Father provides caretaking			
21. C goes to grocery store weekly				42. Reads stories 3 times/wk	0.58/***0.45***		
22. C goes out of house daily				43. Eats one meal with mother and father			
23. Regular check-up				44. Sees relatives			
24. Special place for toys	0.56/**0.31**			45. C has 3 or more books	0.69/***0.48***		
25. Environment free of hazards				*Percent of variance*	11.7	6.7	6.0
					13.3	**5.3**	**5.8**
				Factor label	SID	VRP	NP

Notes: The first of each pair of numbers is the factor loading from Stevens and Bakeman (1985). The second number in **bold** is for the Costa Rica data; those that are ***bold italic*** meet the 0.40 criteria for loading on a given factor.

HOME, Home Observation for Measurement of the Environment; SID, Support for Intellectual Development; VRP, Verbal Responsivity; NP, Non-Punitiveness; C, child; I, interviewer. Note that factor 3 for Costa Rica corresponds to US factor 2.

closely to the first and third factors found by Stevens and Bakeman. Nine of the ten items that loaded on the first factor (Support for Intellectual Development) in the Stevens and Bakeman sample also loaded on factor one for the Costa Rican data (items 18, 31, 32, 33, 34, 38, 40, 42, and 45). The last item (item 24), although failing to meet the 0.40 factor loading cutoff, did load higher on factor one (0.30) than on either of the other factors. Five of the six items loading on the Stevens and Bakeman third factor, labelled Non-Punitiveness—items 9, 12, 13, 16, and 17—loaded together on factor two of the Costa Rican data. Once again, although the last item (item 14) did not have the requisite loading of 0.40 for the Costa Rican data, its highest loading was on this factor (0.35). The loadings for the Stevens and Bakeman second factor (Verbal Responsivity) were only somewhat similar to those for factor three of the Costa Rican data. Two of the five items (items 1 and 2) loading on the Stevens and Bakeman Verbal Responsivity factor loaded on factor three of the Costa Rican data. Item 5, which had a loading in the US sample of 0.40, also had its highest loading in the Costa Rican data on this factor (0.31). For the Costa Rican data, the total percentage of variance accounted for by the three factors was 24.4% (Support for Intellectual Development, 13.3%, Verbal Responsivity, 5.3%, and Non-Punitiveness, 5.8%). The corresponding values from the Stevens and Bakeman sample were similar (Total variance accounted for, 24.4%—Support for Intellectual Development, 11.7%, Verbal Responsivity, 6.7%, and Non-Punitiveness, 6.0%).

HOME Scores and Child Development

The concurrent and predictive validity of the HOME with respect to a child's cognitive function was compared in Costa Rica and the United States by correlations between the HOME subscale and total scores and intellectual assessments in infancy and at 4½ or 5 years of age (Table 4).

Infancy. There were no significant correlations between total HOME or subscale scores and MDI for the Costa Rican sample. In contrast, the correlation between infant total HOME scores and MDI in the Little Rock sample ($r = 0.30$) was significantly higher ($P < 0.05$) than that in the Costa Rican sample ($r = 0.06$). Because the age range of the Costa Rican infants (12–23 months) spans both the one- and two-year age periods reported in some US studies, the data were re-analysed by dividing the Costa Rican sample into younger infants (less than 18 months, $n = 99$) and older infants (18 months or more, $n = 84$). The correlation coefficients were somewhat higher, although not statistically significant. For younger infants, the correlation between total HOME score and MIDI was $r = 0.10$ ($P < 0.31$);

for older infants, the correlation was $r = 0.18$ ($P < 0.11$). In Gottfried's meta-analysis (1984), the mean correlation was $r = 0.17$ for one-year MDI scores and $r = 0.32$ for those obtained at two years. Thus, the correlation coefficient for the Costa Rican sample was similar to the one-year correlations obtained in a variety of US samples.

Five-year Follow-up. Although no significant relationship was found between HOME scores and the Bayley MDI in the Costa Rican sample, the correlations between the HOME and WPPSI scores at five years were statistically significant. A moderate association was obtained between total HOME score and WPPSI Full Scale IQ ($r = 0.28$ for the entire sample, $r = 0.29$ for young infants, and $r = 0.28$ for older infants, $P < 0.02$). These correlations were significantly lower than those reported for Little Rock ($r = 0.53$) but comparable to the meta-analysis summary of Gottfried (1984) (mean $r = 0.38$).

Correlations between the HOME subscale scores and 5-year IQ among the entire Costa Rican sample ranged from $r = 0.09$ to $r = 0.33$, and four subscales showed statistically significant associations ($P < 0.05$). The significant correlations in the Costa Rican sample between IQ and subscale 2 (Acceptance of Child's Behaviour), subscale 3 (Organisation of Environment), subscale 4 (Appropriate Play Materials), and subscale 6 (Variety in Daily Stimulation) were $r = 0.22$, 0.17, 0.33, and 0.28, respectively. These correlations are similar to the meta-analysis summary of Gottfried (1984) (Table 4). In contrast, almost all subscales showed higher correlations with IQ in the Little Rock sample. However, subscale 4, Appropriate Play Materials, showed the strongest correlation in both the Costa Rican and Little Rock samples ($r = 0.33$ in Costa Rica and $r = 0.52$ in Little Rock). Subscale 1 (Emotional and Verbal Responsivity) and subscale 5 (Parent Involvement) were significantly correlated with Stanford-Binet IQ among the Little Rock children but were not correlated with WPPSI-IQ in the Costa Rican sample. Thus, although significant correlations were noted in both the Little Rock and Costa Rican samples, the pattern of subscale correlations differed somewhat between these samples.

The relationship between HOME factor scores and later IQ showed a similar pattern in the United States and Costa Rica. Stevens and Bakeman (1985) found that much of the HOME's predictive ability was carried by those items that clustered under the first factor, Support for Intellectual Development. As noted above, loadings in the Costa Rican sample for factor one were very similar to the Stevens and Bakeman first factor. The Costa Rican data also showed the strongest correlations between the WPPSI scores and this factor ($r = 0.25$, $P < 0.01$), and it correlated with IQ as well as did the total HOME score. Correlations between the other two factors were lower ($r = 0.14$ and $r = 0.01$) and not statistically significant.

TABLE 4
Concurrent and Predictive Validity

Subscale	*HOME and MDI in Infancy*			*HOME and Later IQ*		
	LR (N = 174)	*CR* (N = 183)	*MA* (N = 626)	*LR* (N = 174)	*CR* (N = 147)	*MA* (N = 404)
1. Emotional and verbal responsivity	0.15	0.02	0.12	0.34*[a]	0.11	0.19
2. Acceptance of child's behaviour	0.01	0.04	0.02	0.21*	0.21*	0.19
3. Organisation of environment	0.20	0.07	0.10	0.34*[a]	0.17*	0.16
4. Appropriate play materials	0.28*[a]	0.07	0.18	0.52*[a]	0.33*	0.29
5. Parental involvement	0.28*[a]	0.00	0.14	0.36*[a]	0.09	0.26
6. Variety in daily stimulation	0.05	0.04	0.10	0.32*	0.28*	0.28
Total HOME score	0.30*[a]	0.06	0.17	0.53*[a]	0.28*	0.38

Notes: Values are correlations between HOME scores and developmental tests.

MDI, Mental Development Index from Bayley Scales of Infant Development. IQ, Stanford-Binet Test at 4½ years for the Little Rock sample (LR), Wechsler Preschool and Primary Scales of Intelligence at 5 years for Costa Rica (CR), and both Stanford-Binet scores and McCarthy General Cognitive Index for Gottfried's five-study meta-analysis (MA).

The Little Rock and meta-analysis correlations are for HOME scores at 12 months (Bradley et al., 1986; Gottfried, 1984), the age point closest to the 17-month mean age of Costa Rica sample.

[a] The correlation is significantly higher than that observed in the Costa Rica sample.

* Correlations within a given sample are statistically significant at $P < 0.05$. Significance levels are not published for the meta-analysis summary data.

HOME Scores and Measures of Socioeconomic Status

Research in the United States has shown that the HOME generally predicts future cognitive development independently of measures of socioeconomic status (Gottfried, 1984; Gottfried & Gottfried, 1986). To determine whether or not this would also be true in the present study, correlations between maternal education, cognitive tests, and HOME scores were compared. Mother's education (in years) was unrelated to MDI scores in infancy ($r = 0.11, P < 0.16$). However, the relationship between maternal education and the child's Full Scale IQ at five years was statistically significant ($r = 0.40$, $P < 0.001$). Maternal education and HOME scores were themselves related ($r = 0.36$, $P < 0.001$). HOME scores were still significantly related to children's IQ scores after controlling for mother's education ($\beta = 0.16$, $P = 0.05$, additional variance explained = 2%), indicating that, as in the United States, the home environment exerted an influence on cognitive development independent of maternal education. However, the effects of both HOME scores and maternal education became nonsignificant when maternal IQ was entered as an additional control variable in a multiple regression model.

HOME Scores and Child Health

To determine if the HOME differentiated other child outcomes in the Costa Rican study, information on feeding practices, iron status, and growth was analysed. The HOME correlated with the duration of breastfeeding ($r = 0.19$, $P < 0.01$), such that lower scores were associated with shorter nursing. Maternal education was unrelated to breastfeeding ($r = 0.01$, n.s.). There was a striking difference in HOME scores between children with moderate iron deficiency anaemia in infancy (haemoglobin level ≤ 10.0 grams per decilitre, and two of three abnormal iron measures) and those without (Lozoff, et al., 1991). The HOME scores of the anaemic group averaged 25.6 ± 6.3, compared to 30.7 ± 6.5 for the rest of the sample ($P < 0.001$). Mother's education did not relate to this aspect of child health. Neither HOME scores nor maternal education were correlated with birthweight, growth, or lead levels, but the study by design excluded children who were outside the normal limits on these parameters. Comparable US data are not available, as child outcome has generally been restricted to IQ scores in most US studies of the HOME's validity.

DISCUSSION

The psychometric properties of the HOME in this group of Costa Rican children were similar to those of the original US sample in Little Rock. The

mean total score in the Costa Rican sample compared favourably to that of the Little Rock sample. Internal consistency measures for HOME subscale and total scores were also comparable in the two groups. The need for culture-specific annotations turned out to be quite limited, with the most notable exceptions related to differences in the health care system, to stimulation that used household items instead of toys, and to the involvement of family members other than the mother in reading to the child. In addition, factor analysis of the Costa Rican data showed a factor structure similar to that obtained in the United States by Stevens and Bakeman (1985).

These similarities in psychometric properties are striking and surprising in view of the major cultural differences in the study populations. The results raise the possibility that certain paternal behaviours cluster together regardless of culture. However, it should be noted that Costa Rica is an industrialising nation with an educational system and economic structure that are not radically different from that in the United States or Europe. The question of culture-independent groupings of parental behaviour can be answered only by conducting studies of the psychometric properties of the HOME in a variety of other cultures, including some with very different educational systems and distinct subsistence types, such as hunting and gathering societies, nomadic or herding cultures, and agricultural communities.

In contrast to the similarities in psychometric properties, the relationships between HOME scores and cognitive function were not as pronounced in the Costa Rican sample as in the Little Rock sample. There were no significant correlations between Costa Rican HOME subscale or total scores and Bayley MDI. In the Little Rock study, significantly higher correlations were noted, ranging up to $r = 0.40$. The correlations between HOME scores in infancy and cognitive function at 4½ or 5 years were statistically significant in both samples, but significantly lower in Costa Rica than in the original US sample. The magnitude of correlations observed in the Costa Rican sample are more in line with the meta-analysis of Gottfried (1984). Maternal education and HOME scores made independent contributions in predicting later IQ scores, both in the Costa Rican sample and in most US studies.

The observations of limited correlation between HOME scores and cognitive development in a Latin American population parallel the findings of a recent collaborative study by Bradley and associates (Bradley et al., 1989). The study, which represents six different project sites in the United States, is a longitudinal investigation of the relationship between home environment and developmental outcome in three ethnic groups (black, Hispanic, and white). The results showed that the Mexican-American sample had the lowest correlation between HOME scores and cognitive

tests among the ethnic groups. The magnitude of correlations for infant assessments in the Mexican-American ethnic group was like that in Costa Rica. Specifically, there was no relation between HOME and Bayley MDI. However, correlations with later IQ in the Mexican-American sample showed no significant relationship ($r = 0.10$), whereas a modest, statistically significant association was found for the Costa Ricans ($r = 0.28$). The predictive ability of the HOME was also limited in the only other available study of Mexican-American children, an intervention study by Johnson, Breckenridge, and McGowan (1984). The correlations between 12-month HOME and 36-month IQ were nonsignificant ($r = 0.17$ and 0.25, in control and programme groups, respectively).

These lower HOME correlations among Mexican-American and Costa Rican samples were observed even though there are important differences in the populations. Families in the Houston samples were members of an ethnic minority in the United States, and were, in general, culturally disadvantaged. Recency of immigration and degree of acculturation were factors not applicable to the Costa Ricans. Also, the US studies differed from the Costa Rican study in length of follow-up (3 years vs. 5 years). Nonetheless, the lower correlations between HOME and cognitive test scores among a Latin American population in Costa Rica and Mexican-American samples in the United States were similar and contrast with findings in US white or black samples. Two recent studies of non-US black populations also contrast with the Hispanic results. In a study of Haitian-Americans, the correlation between HOME and 12-month MDI was 0.25 (Widmayer et al., 1990). In a study of urban South African black infants, an interview measure modelled on the HOME also correlated with MDI scores ($r = 0.33$; Richter & Grieve, 1991). Thus, the low correlations in Hispanic samples stand out.

In the Costa Rica sample, this finding is not due to a limited range of scores for HOME, Bayley MDI, or IQ, because the mean and standard deviation were similar to those in Little Rock for the HOME and to those in the standardisation samples for the Bayley and the WPPSI. It is possible, however, that the lower correlations are due to unreliability in the developmental measures as used in Costa Rica. Alternately, the observed lack of association would seem to support the interpretation of Bradley et al. (1989) and Laosa (1981, 1983) that there may be cultural differences not only in parental behaviours but also in how they affect children's development. Garcia Coll (1990, p. 283) notes: "it seems that other factors might play a more significant role ... or that these measures [such as the HOME] are not picking up subtle aspects of individual variation." One candidate for an important but understudied factor might be the extended family. If the extended family (and their households) play a more prominent role in the lives of Hispanic children than either white or black children, then the

HOME as it is usually administered might not record major sources of stimulation (or lack thereof) and other critical influences for the development of Hispanic children. The degree of involvement of the extended family could be assessed in future studies of ethnic and cultural differences in the relationship between the HOME and children's cognitive development.

Another possibility is that the HOME is sensitive to relevant variation in the home environment in other cultures, but that limiting child outcome to IQ scores is too restrictive. In the present study, the HOME clearly differentiated children with iron deficiency anaemia in infancy. This condition identifies children at risk for long-lasting developmental disadvantage relative to their peers, even if the anaemia is corrected (Lozoff et al., 1991; Palti, Meijer, & Adler, 1985; Palti, Pevsner, & Adler, 1983; Walter, De Andraca, Castillo, Rivera, & Cobo, 1990). Similarly, the HOME differentiated malnourished children (Cravioto & DeLicardie, 1972; Chase & Martin, 1970). Generalised undernutrition in infancy is another condition that identifies children at long-term developmental risk (Galler, 1984). These results suggest that measures like the HOME may give new ideas about environmental influences on child health, which in turn affects later development. Such findings broaden the scope of the HOME in addressing the questions of how the home environment influences not only the cognitive stimulation a child receives but also the food and physical attention required for good health and development.

The present study extends work on the HOME in the United States by describing the psychometric properties and correlates of the HOME in a group of Latin American children in their country of origin. The study is only a starting point for future work. It does not standardise the HOME for Costa Rica, in particular, or for Latin American countries, in general. These countries are heterogeneous in the degree of urbanisation, industrialisation, and the admixture of indigenous populations within them. Nonetheless, the similarities in many psychometric properties between HOME data for Costa Rica and the United States are striking. The results also indicate that qualities of the home environment cluster in similar ways in two different cultures. The moderate, statistically significant correlations between HOME scores and IQ in the Costa Rican population indicate that, despite cultural factors influencing the relationship, the HOME does indeed tap into some aspects of a cognitively stimulating environment in a Latin American environment. However, the observation that this relationship is not as strong in Hispanic populations as it is in both white and black populations outlines the need for further research into cultural influences on cognitive development. The relationships between the HOME and child health in this study and in studies of malnutrition, also suggest that the focus on IQ scores

in assessing the HOME's validity has been too narrow. A more inclusive view of the concept of outcome may improve our understanding of important environmental influences on child health and development.

Manuscript received 3 July 1992
Revised manuscript received 28 October 1993

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